



## United States Patent [19]

Cruce et al.

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- [54] SIGNAL GENERATION AND MIXING  
ELECTRONICS FOR FREQUENCY-DOMAIN  
LIFETIME AND SPECTRAL FLUOROMETRY**

- [75] Inventors: **Tommy C. Cruce, Leander; William H. Hallidy; Robert C. Chin, both of Austin, all of Tex.**

- [73] Assignee: **Systems&Processes Engineering Corporation, Austin, Tex.**

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- [51] Int. Cl.<sup>6</sup> ..... G01N 21/64

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356/317

- [58] **Field of Search** ..... 250/458.1, 459.1,  
250/461.1; 356/318, 317

[56] **References Cited**

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*Primary Examiner*—Edward P. Westin

*Assistant Examiner*—Richard Hanig

**Attorney, Agent, or Firm**—Strasburger & Price; Matthew J. Booth

[57] **ABSTRACT**

The present invention additionally comprises a method and apparatus for generating and mixing signals for frequency-domain lifetime and spectral fluorometry. The present invention comprises a plurality of signal generators that generate a plurality of signals where the signal generators modulate the amplitude and/or the frequency of the signals. The present invention uses one of these signals to drive an excitation signal that the present invention then directs and transmits at a target mixture, which absorbs the energy from the excitation signal. The property of fluorescence causes the target mixture to emit an emitted signal that the present invention detects with a signal detector. The present invention uses a plurality of mixers to produce a processor reference signal and a data signal. The present invention then uses a processor to compare the processor reference signal with the data signal by analyzing the differences in the phase and the differences in the amplitude between the two signals. The processor then extracts the fluorescence lifetime and fluorescence spectrum of the emitted signal from the phase and amplitude information using a chemometric analysis.

**25 Claims, 6 Drawing Sheets**

